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ABSTRACT

This annotated bibliography includes summaries of 19 articles and reports dealing with noise control and acoustical design in school buildings. A brief introduction discusses the need for careful attention to acoustics in any school construction or remodeling project, with particular emphasis on the need for special acoustical measures in an open plan facility. Annotations range from approximately 50 to 150 words. (JG)

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NOISE AND SOUND CONTROL IN OPEN PLAN SCHOOLS

Ben Schellenberg

[75]

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Open space planning in school design has attracted considerable attention among educators in the past ten years. Whether this concept is called "school landscaping" or "open planning", it was introduced as a functional concept rather than a visual expression.

There are times where this concept will suggest the use of some conventional partitioned space; but, more often, the concept can be carried out most effectively when the space is not rigidly divided, but separated into various teaching stations by movable furniture. This furniture provides a degree of visual and acoustical privacy while permitting flexible use of the teaching area.

While there are well-founded reasons for considering this type of school layout, a number of potential problems must be given careful consideration. The acoustical design of these spaces is one of the most important factors to consider. School designs which do not enhance audio-communication have failed in fulfilling one of the primary purposes of the building. Good acoustics in a school facility result from designing appropriate features which require foresight by the school planners and administrators. It is important that an acoustical consultant, experienced in school landscape acoustics, be hired early in the design stage of a construction project.

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It is insufficient to just think of avoiding poor acoustics; rather the focus should be on providing acoustical characteristics that contribute and enhance the activities in the various spaces of the school. If this is the goal, then beginning early in the planning

stages of a school construction project (rennovation or new construction), consideration should be given for acoustical needs and design of the facility. Included in this should be the examination of the site, exterior landscaping and the design of the proposed facility in terms of noise generation and the noise tolerance levels of various school activities. School planners need to secure data on present and projected noise levels of each site under construction. The topography and sub-soil characteristics of a site have long been studied prior to selection of a site and location of a building. Noise levels need to be studied as well, for a location with high noise would require more extensive and expensive attention to acoustical properties of exterior walls. The topography of the site, including trees, shrubbery and lawns affect the acoustical environment. The location of a building on a particular site, the arrangement of the school buildings and the grouping of the area within the school has acoustical implications, hence the noise reduction required to minimize interference in the classroom may be reduced.

One of the current trends in the construction of new and rennovation of old school buildings is designing classrooms without partitions. Achieving acoustical separation of teaching stations places greater emphasis on the selection and arrangement of furnishings. This may significantly reduce the adverse effects of sound reverberation within the teaching space.

The use of "masking sounds" (for example, background music) can be helpful in concealing intermittent and distracting sounds such as conversations from adjacent areas, equipment noise, chair scraping,

etc. The ability to mask the intelligibility of speech sounds depends on the characteristics of the acoustical materials in the area and the composition of human speech. Electronic background sound masking systems have been developed which can individually tune in a section of an open space area so that the masking sound is exactly adjusted to the acoustics and the noise environment of the area. Open office space has used this technique effectively. Some preliminary experimentation is taking place in schools to determine its effectiveness.

The primary material used in sound control in schools is carpeting. Carpets should be specified by a noise reduction coefficient which would identify the fibers most appropriate for a given area.

A review of the reports available on school acoustics indicates that acoustical treatment must be thought of as more than just removal of noise.

In many older school buildings walls have been removed to provide open spaces for flexible styles of instruction. Frequently these older buildings received no acoustical treatment to compensate for the open space. Many of the schools with this type of environment use the individualized instruction program where there is movement around the room by students to find and check assignments and to use various instructional materials. All of these conditions contribute to a higher noise level than you might find in a self contained traditional type classroom.

A review of the listed research available in comparing the performance of students in the open space classroom with all the noise factors to that of the more traditional, self contained approach

indicates limited or no significant difference. One study concluded that teachers who complain and are aware of noise in the open space classroom are more likely compensating for the absence of visual security. The importance of adequately preparing teachers to moving into the open teaching station is extremely significant.

There is only an alluding to the psychological impact of inadequate acoustics on an individual. Additional research is needed to more effectively ascertain the impact of noise in the open space teaching areas on students learning as well as the level of noise that might be damaging to individual students.

The sound levels in schools vary a great deal, being affected by a number of factors, including: location of the buildings, exterior noise levels, interior noise levels (air conditioning, etc.), and by the nature of the activity--the most influential factor.

Since our children spend a major portion of their "prime time" in school, they deserve an acoustical environment free of potentially hazardous sound levels and one conducive to learning.

Caffarella, Edward P., Jr. "The Acoustics of Educational Facilities", Audiovisual Instruction, 18, 10, December 1973, p 10-11.
EJ 094 572

Acoustical conditions in a classroom which contribute to ease in listening are controlled by two concepts: absorption and reverberation.

Absorption is the ability of a given material to take in sound. Reverberation is the length of time a sound can be heard. The proper combination of absorption and reverberation in a room make it acoustically conducive to activities planned for the room.

The article contains pointers on various acoustical treatments that could be utilized in developing an effective learning environment.

The author suggests that not only the construction of an area but the ultimate purpose should have an impact on the planning. This is especially important as schools include more large group instructional facilities.

Cannaday, Jefferson Curtis "A Study of Noise Levels in Selected Public School Situations", Unpublished Doctoral Dissertation, East Texas State University, 1971. 139p.

The design of the research was to determine existing noise levels in selected Northeastern Texas public schools situations and to determine if significant differences in noise levels existed among the schools studied. A sub-problem was to observe conditions which might be capable of inducing hearing loss or might cause unfavorable psychological or physiological responses.

The research established these findings:

1. Community size appeared to have a direct relationship to noise within the schools; noise levels increased with increased community size. More significant increases appear to occur among secondary schools than among elementary schools.
2. Types of pupil ability had a definite relationship to interior noise levels.
3. Data analysis indicated that consistently higher DB readings occurred in band rehearsal halls, wood/metal shops, and in physical education classes.
4. Based upon United States Department of Labor guidelines, it was concluded that some public school students were regularly exposed to sounds of sufficient intensity to result in possible hearing loss.

Carpenter, Les E. "Acoustical Wall Panels Control Gymnasium Noise at High School", Building Operating Management, 21, 8, September 1974, p 21-22. EJ 105 848

Architects who designed the high school gymnasium at Mesa, Arizona, have reduced the decible level to human ear, the frenzied shouts of some 1,700 adolescents rooting their basketball team.

This was accomplished by designing the walls so they sloped out at the top at both ends of the playing court so there would not be two parallel walls facing each other. Some eighty sound abosrbent wall panels were hung along side the walls.

This article contains a description of the planned process to be used in acoustically treating the industrical arts building to achieve an acceptible decible level for students and instructors.

Choudberry, N. K. D. "Sound Diffraction Around Movable Partitions in Teaching Spaces", Educational Building Report, 1973. 61p.

This study researches the diffraction of sound around flexible partitions used in teaching spaces and includes a comprehensive study of acoustical conditions in several school buildings. The study contains information on measurement of noise reductions of some typical flexible partitions.

The current trend is to use these partitions for dividing teaching spaces. Consequently, the minimum height of the partitions between two teaching spaces, the material of the partition, position of the chalkboard, etc., were some of the important factors which are considered in the study. Noise levels prevailing in classrooms of different schools were also measured to determine the acoustical conditions.

The study lead to the following conclusions:

1. No child should be more than seven meters away from the teacher.
2. Flexible partitions should have a noise reduction of at least four db.
3. The partition height should be 2 meters when teachers are back to back and 2.4 meters when they are in opposite ends of adjoining classrooms.
4. Noise levesl in classrooms should not exceed 60 db.

Cutler, Marilyn H. "Intermediate, Open and Carpeted, Branford's a School That Could Give You Ideas", The American School Board Journal, 160, 5, May 1973, p 48-49.
EJ 075 622

This article describes characteristics of a school that has won an honor award from the Connecticut Chapter of the A.I.A. The author identifies the processes used by the school board in the planning and construction of the school facility.

Coping with the inevitable reverberation problems of open space and providing a tranquil atmosphere for 1,500 students was accomplished through carpeting. Extensive installation of carpeting such as the one at Branford could even make a few of the floor covering's fans gasp. Three and one-half acres of carpet--some 200,000 square feet--to muffle or absorb auditory distractions.

The article contains further information on the blending of the visual and acoustical elements in carpeting the school.

Dole, Edwin K. "What is Carpet", The American School Board Journal, 160, 5, May 1973. p 45-47.

EJ 075 622

The author describes the history of carpeting in public schools. He intimates that it should be included in the planning of a school facility rather than emerging as an afterthought. He describes the primary function of carpeting within the classroom is to control sound.

A carpet installed in schools should be specified by a noise reduction coefficient with a rating of value that should measure 45. This means that 45 percent of airborne sound waves coming in contact with the carpet are absorbed.

This article contains a guide designed especially with educational requirements in mind which could serve as a point of reference in carpet selection by rating fibers according to five identified characteristics.

Fitzroy, Daniel "What You Should Know About Acoustics", School Management, 14, 8, August 1970, pp 20-27.
EJ 024 249

Two acoustical architects studied the acoustical design of forty schools under a grant from the Educational Facilities Laboratories. Their conclusion based on the survey was that competent acoustical design is lacking in a substantial portion of American schools.

The author identified and described three basic qualities that affect acoustical environment (sound absorption, sound interception, and sound manipulation).

The article contains the study of nine types of school spaces which include the open classroom where they identify the acoustical problem, what may be a standard solution and what they suggest would be a better way for effective sound absorption in each of the rooms.

Frese, Claudia W. "Give Your School the Silent Treatment", American School and University, 46, 2, October 1973, pp 47-52.
EJ 084 496

The author was awarded a research grant to determine the efficient placement of carpeting to control noise in school traffic areas. The purpose of the study was to conduct a series of scientifically controlled field experiements to: measure noise levels before and after installation of floor carpet. wall carpet, and combinations of floor and wall carpet; and evaluate the efficiency of carpet installation in terms of noise reduction.

The testing procedure used in obtaining data and the results are included in the study. Results of the study concluded that floor carpeting reduced the overall nosie level by 37 percent, wall carpeting by 24 percent, and the combination of floor and wall carpeting by 51 percent, when compared with the noise level prior to carpet installation.

The author concluded that as schools become aware of the psychological effects of noise on the performance of students and teachers additional solutions will be mandated.

Gilliland, John W. Information Concerning Preparation of Specifications for Carpeting. Paper presented at Council of Educational Facility Planners Annual Conference (47th, Oklahoma City, Oklahoma), October 5-8, 1970. 7p. ED 048 662

This paper argues for detailed, written carpeting specifications to assure that schools obtain quality products at competitive prices. The advantages of and specifications for school carpeting are given. A sample written specification contains items on: scope, general features, materials, acoustic characteristics, identification and acoustic properties, and installation. A list of carpeting term definitions concludes the article.

Hamman, Stratton "Sound Polluted Schools", School Management, 14, 11, November 1970. p 14-15.
EJ 028 197

The Louisville Board of Education hired an acoustical consultant to research the sound level readings of an elementary school and a high school. The purpose was to determine how much of an increase in sound can be tolerated in the classroom before steps must be taken either to control the sound or alter the structure in such a manner that the noise level is abated on the inside.

The findings indicated that it is not only the pressure level of sound, expressed in decibels, which is important in evaluating the sound situation at a school, but also the kinds of sounds. The researchers determined that a droning monotonous constant background noise can be tolerated in a classroom whereas a varied or beating noise (such as rock music) of equal intensity is not tolerated.

Kingsbury, H. F. "Acoustics in the Changing Classroom",
Educational Technology, 13, 3, March 1973, pp 62-64.
EJ 075 179

The advent of educators seeking alternative and better ways of teaching has incurred construction costs to spiral. The teaching process has changed as has the facility design. The author contends that classroom acoustics is still treated in the same manner as is the conventional classroom.

The author identifies two criteria for consideration in the planning and construction of new schools. These are the noise present in unoccupied classrooms and the amount and placement of acoustical absorption. The open classroom concept presents a problem of restricting the speech signal so that it is intelligible at the farthest student position in a class segment and inaudible at the closest student position in the next segment. The choice of noise levels is not easily made since the factors of distance, absorption, presence or absence of part height barriers and space arrangements all enter into such determinations.

The article details alternative methods of treating an environment to obtain an effective learning station.

Kingsbury, H. F.; Strumpf, F. M. The Development and Testing of Guidelines for Designing School Classrooms to Maximize Hearing Conditions and Provide for Effective Noise Control. Final Report. Pennsylvania State University, University Park College of Engineering, November 1969. 91p.
ED 040 603

Speech intelligibility was tested in three classroom type spaces, one of 700 square feet, and two of 2000 square feet, using student listeners and recorded test material. One of the latter two classrooms was fully carpeted. The test material used was Modified Rhyme Test (MRT) tapes, presented via tape reproducer and loudspeaker. Also investigated were the expected signal attenuation over distance in these classroom spaces and the effect of added noise on speech perception. Based on statistical analysis of the results the tests, the following conclusions were drawn: the MRT tapes are a valuable research tool in determining speech intelligibility using live observers; there are no differences between the test lists; at the same level of presentation, there is no difference in speech intelligibility for female versus male speakers, and the signal attenuation in typical classroom spaces is a straight logarithmic function and approaches free field conditions in classrooms with large amounts of acoustical absorption on the floor and ceiling. From these results, a set of acoustic guidelines were drawn that can lead to significant improvement in speech perception in actual classrooms.

Knick, Frederick G. "Acoustical and Visual Environments Affect Learning", Audio Visual Instruction, 15, 8, October 1970. pp 34-35.
EJ 028 281

Facilities planning needs to take into consideration those design features which affect learning. Facilities should be stimulating to the learner and should enhance the teaching/learning process. The design of acoustical and visual environments can be established by an instructional technologist to facilitate learning tasks. This report describes the procedures and criteria for determining the element of effective acoustical properties and visual environment, and how they influence the learning process.

Activities for a given room with equipment specification will enhance the functionability of the physical resources. The activities may change with time, therefore, the specification developed by the architect/ instructional technologist team should result in facilities with multiple use.

Kyzar, Barney L. Comparison of Instructional Practices in Classrooms of Different Design. Final Report. Natchitoches, La.; Northwestern State University, January 1971. 76p.

ED 048 669

This study compared various instructional practices and problems in open plan classrooms with practices and problems in conventional plan school buildings. One secondary and three elementary schools having open plan classrooms were each paired with a comparable school having conventional classrooms. Instruments were used to record: teaching techniques, psychological climate, social differences, and activities used in the instructional program. A sound survey was conducted in each of the schools to determine the amount of noise transmitted between instructional areas or rooms, and sound level readings were taken during instructional periods to ascertain actual classroom noise levels. The evidence gained in the investigation indicated that noise is not a problem in open space schools.

Meyer, Jo Ann; Wurster, Stanley R. The Effect of Three Noise Levels on Task Attention and Performance in Reading and Math with Fifth and Sixth Grade Children. January 1972. 30p.

ED 082 327

For this study, a 5th and 6th grade team taught classroom of 66 children was chosen. Three equivalent groups of 22 children each were matched on the basis of a pretest in math. Each group was given a different noise level treatment: quiet (45-55 decibels), average (55-70 decibels), and a noisy (75-90 decibels). A tape recording of actual classroom noise was used for the average and noisy treatments and a soundproof room was used for the quiet treatment. The noise treatments were randomly assigned to each group. Math computation and reading sections of the Metropolitan Achievement Test, Form G, provided the study tasks. Measurements of task attention were taken every two minutes using a criterion for task attention. An analysis of variance showed no significant difference in the groups either in task attention or in math and reading performance.

Perin, Rein "Acoustical Misconceptions In Open Planning", Progressive Architecture, 53, 7, August 1972, pp 74-75.
EJ 061 902

In this article the author reviews the acoustical rights and wrongs of open planning, identifies the limitations and suggests that success, at least in a relative sense, is within the reach of an alert designer.

Schools built during the first rush of the open-plan concept displayed a lack of acoustical quality. They are carpeted, the ceilings may be somewhat absorptive, and free-standing screens are used to "isolate" the micro-spaces from each other. Everything else is conventional, which may or may not include specific provisions for mechanical noise control. The author concludes that the acoustical failure of such spaces is not surprising.

Turner, Aaron Lynn Sound Levels in East Texas Schools. East Texas State University, Commerce, 7, 3, 1970. 14p.

ED 043 957

A survey of sound levels was taken in several Texas schools to determine the amount of noise and sound present by size of class, type of activity, location of building, and the presence of air conditioning and large amounts of glass. The data indicates that class size and relative amounts of glass have no significant bearing on the production of sound in a classroom, but that air conditioning, the location of the building with accompanying exterior noise levels, and the nature of the classroom activity did have significant effects on sound levels, the last factor being the most influential. School planners should pay more attention to the acoustical environment in an attempt to abate noise levels.

Walsh, David P. Rating System for Evaluating the Acoustical Environment of Existing School Facilities. Paper presented at Acoustical Society of American Annual Meeting (82nd, Denver, Colorado), October 22, 1971. 19p. ED 062 692

A major survey of all schools built prior to 1933 was conducted after the enactment of the Field Act, which, in California, required specific school construction standards for earthquake safety. One aspect of this study, the acoustical environment of San Francisco Schools, is described in this speech. The document outlines the following procedures: (1) for the acoustical portion of the survey, a field survey was made to establish the existing condition at the facilities; (2) deficit documentation, which involved matching the existing conditions against the district standards by computer, was then completed; (3) unit costs for corrective work on all substandard areas were developed; and (4) cost benefit tables that matched the deficit documentation with the unit costs for corrective action were established. Portions of the forms used and computer printouts are included.

Whitehead, Jack L. Effects of Noise on Small Group Interaction. Paper presented at the Annual Meeting of the Speech Communication Association (58th, Chicago, Illinois), December 27-30, 1972. 15p.
ED 073 502

This study reports an analysis of the effects of moderate levels of noise on task performance of an interacting group. Groups of students first interacted in information-sharing discussions under varying conditions of noise and then responded to an objective test over the shared information and to a series of semantic differential scales designed to measure their subjective responses to noise. Four groups of five subjects each were assigned to each of three experimental conditions and one control condition. Measures were obtained of group task performance and of subjective perceptions of noise under conditions that included 50, 60, and 70 dBC levels. Results showed that performance on information-sharing tasks by small groups was unaffected by moderate levels of outside noise, although there were differences in the subjects' perceptions of the noise.

BIBLIOGRAPHY

Caffarella, Edward P., Jr. "The Acoustics of Educational Facilities". Audiovisual Instruction, 18, 19, December 1973. p 10-11.

Cannaday, Jefferson Curtis, "A Study of Noise Levels in Selected Public School Situations", Unpublished Doctoral Dissertation, East Texas State University, 1971. 139p.

Carpenter, Les E. "Acoustical Wall Panels Control Gymnasuim Noise at High School", Building Operation Management, 21, 8, September 1974. p 21-22.

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Frese, Claudia W. "Give Your School the Silent Treatment" American School and University, 46, 2, October 1973. p 47-52.

Gilliland, John W. Information Concerning Preparation of Specifications for Carpeting. Paper presented at Council of Educational Facility Planners Annual Conference (47th, Oklahoma City, Oklahoma), October 5-8, 1970. 7p.
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